

CLAIMS

What is claimed is:

1. A method of measuring fullness of a cryopump comprising:
coupling a pressure gauge in fluid communication with a vacuum region
5 behind a condensing surface of a cryopump; and
measuring pressure with the pressure gauge.
2. A method as in Claim 1 wherein the pressure gauge is an ion gauge.
3. A method as in Claim 1 wherein coupling the pressure gauge in fluid
communication with the vacuum region includes connecting the pressure gauge
10 to a tube or duct leading to the vacuum region.
4. A method as in Claim 1 further including adsorbing gases at the condensing
surface, the adsorbed gases consisting substantially of low-boiling-point gases.
5. A method as in Claim 4 wherein the low-boiling-point gases include at least one
of hydrogen, helium or neon.
- 15 6. A method as in Claim 1 wherein the vacuum region behind the condensing
surface has a pressure which is at least one order of magnitude less than a
process chamber coupled to the cryopump.
7. A method as in Claim 1 wherein the condensing surface further includes an array
of baffles coated with an adsorbent.

8. A method as in Claim 1 wherein the cryopump further includes first and second stage arrays, the condensing surface is within the second stage array.
9. A method as in Claim 8 wherein a partial pressure of hydrogen inside the second stage array is lower than a partial pressure of hydrogen outside the second stage array.
10. A method as in Claim 1 further comprising determining a pumping capacity of the cryopump using the measured pressure.
11. A method as in Claim 8 further includes predicting a pumping capacity for low-boiling-point gases based on the measured pressure.
- 10 12. A method as in Claim 1 further comprising determining an adsorption capacity of the cryopump using the measured pressure.
13. A cryopump comprising:
 - a closed cycle refrigerator;
 - a condensing surface cooled by the refrigerator; and
 - 15 a pressure gauge in fluid communication with a vacuum region behind the condensing surface.
14. A cryopump as in Claim 13 wherein the pressure gauge is an ion gauge.
15. A cryopump as in Claim 13 wherein the pressure gauge is connected to a tube or duct leading to the vacuum region behind the condensing surface.

16. A cryopump as in Claim 13 wherein gases are adsorbed within the condensing surface, the adsorbed gases consisting substantially of low-boiling-point gases.
17. A cryopump as in Claim 16 wherein the low-boiling-point gases include at least one of hydrogen, helium or neon.
- 5 18. A cryopump as in Claim 13 wherein the vacuum region behind the condensing surface has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.
19. A cryopump as in Claim 13 further includes first and second stage arrays cooled by the refrigerator, and the second, colder stage further including the condensing
10 surface.
20. A cryopump as in Claim 19 wherein the condensing surface of the second, colder stage further includes:
a second stage cryopanel surrounded by a radiation shield, the cryopanel having an array of baffles coated with an adsorbent, the baffles being coupled to
15 and in close thermal contact with a heat sink on the second, colder stage.
21. A cryopump as in Claim 19 wherein a partial pressure of hydrogen inside the second, colder stage is less than a partial pressure of hydrogen outside the second, colder stage.
22. A cryopump as in Claim 13 further comprising an electronic controller which
20 measures pressure with the pressure sensor, the controller including computer program instructions which determine a pumping capacity based on the measured pressure.

23. A cryopump as in Claim 22 wherein the controller further includes instructions to predict a pumping capacity of the cryopump for low-boiling-point gases based on the measured pressure.
24. A cryopump as in Claim 13 further comprising an electronic controller which
5 measures pressure with the pressure sensor, the controller including computer program instructions which determine an adsorption capacity for the condensing surface using the measured pressure.
25. A system for measuring fullness of a cryopump comprising:
a means for coupling a pressure gauge in fluid communication with a
10 vacuum region behind a condensing surface of a cryopump; and
a means for measuring pressure with the pressure gauge.
26. A method of measuring fullness of a cryopump comprising:
connecting a pressure gauge in fluid communication with a vacuum
region enclosed by cryopumping surfaces; and
15 measuring pressure with the pressure gauge.
27. A method according to Claim 26 wherein the pressure gauge is an ion gauge.
28. A method according to Claim 26 wherein connecting the pressure gauge in fluid communication with the vacuum region includes connecting the pressure gauge to a tube or duct leading to the vacuum region.
- 20 29. A method according to Claim 26 further including adsorbing gases at the cryopumping surfaces of the cryopump, the adsorbed gases consisting substantially of low-boiling-point gases.

30. A method according to Claim 29 wherein the low-boiling-point gases include any of hydrogen, helium or neon.
31. A method according to Claim 26 wherein the vacuum region enclosed by cryopumping surfaces has a pressure which is at least one order of magnitude
5 less than a process chamber coupled to the cryopump.
32. A method according to Claim 26 wherein the cryopumping surfaces further include an array of baffles coated with an adsorbent.
33. A method according to Claim 26 wherein the cryopump further includes first and second stage arrays, the cryopumping surfaces being within the second stage
10 array.
34. A method according to Claim 33 wherein a partial pressure of hydrogen inside the second stage array is less than a partial pressure of hydrogen outside the second stage array.
35. A method according to Claim 26 further comprising determining a pumping
15 capacity of the cryopump using the measured pressure.
36. A method according to Claim 35 further includes predicting a pumping capacity for low-boiling-point gases based on the measured pressure.
37. A method according to Claim 26 further comprising determining an adsorption capacity of the cryopumping surfaces using the measured pressure.
- 20 38. A cryopump comprising:
a cooled condensing surface; and

a pressure gauge in fluid communication with a vacuum region enclosed by the condensing surface.

39. A cryopump according to Claim 38 wherein the pressure gauge is an ion gauge.
40. A cryopump according to Claim 38 wherein the pressure gauge is connected to a
5 tube or duct leading to the vacuum region enclosed by the condensing surface.
41. A cryopump according to Claim 38 wherein condensing surface is used to adsorb gases, the adsorbed gases consisting substantially of low-boiling-point gases.
42. A cryopump according to Claim 41 wherein the low-boiling-point gases include
10 at least one of hydrogen, helium or neon.
43. A cryopump according to Claim 38 wherein the vacuum region enclosed by the condensing surface has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.
44. A cryopump according to Claim 38 further includes first and second stage arrays
15 cooled by the refrigerator, and the second, colder stage further including the condensing surface.
45. A cryopump according to Claim 44 wherein the condensing surface of the second, colder stage further includes:
20 a second stage cryopanel surrounded by a radiation shield, the cryopanel having an array of baffles coated with an adsorbent, the baffles being coupled to and in close thermal contact with a heat sink on the second, colder stage.

46. A cryopump according to Claim 45 wherein a partial pressure of hydrogen inside the second, colder stage is less than a partial pressure of hydrogen outside the second, colder stage.
- 5 47. A cryopump according to Claim 38 further comprising an electronic controller which measures pressure with the pressure sensor, the controller including computer program instructions which determine a pumping capacity based on the measured pressure.
- 10 48. A cryopump according to Claim 46 wherein the controller further includes instructions to predict a pumping capacity of the cryopump for low-boiling-point gases based on the measured pressure.
- 15 49. A system for measuring fullness of a cryopump comprising:
a means for connecting a pressure gauge in fluid communication with a vacuum region enclosed by cryopumping surfaces; and
a means for measuring pressure with the pressure gauge.